UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

SAN FRANCISCO DIVISION

FRANCE TELECOM S.A., Plaintiff, vs. MARVELL SEMICONDUCTOR, INC., Defendant.	Case No. 12-CV-04967-WHO **DECLARATION OF DR. PAUL S. MIN REGARDING CLAIM CONSTRUCTION** Date: Time: Place: Courtroom 2, 17th Floor, San Francisco Courthouse Judge: Hon. William H. Orrick

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I, PAUL S. MIN, PH.D., declare as follows:

I. INTRODUCTION

1. I have been retained by counsel for Defendant Marvell Semiconductor, Inc. ("Marvell") as an expert to analyze and explain what certain terms in Claims 1 and 10 of U.S. Patent No. 5,446,747 ("the '747 patent") would mean to a person of ordinary skill in the art at the time of the alleged invention.

2. I understand that France Telecom contends that the asserted claims of the '747 patent claim priority to French Application No. 91 05280 and are entitled to a priority date of at least as early as April 23, 1991.

3. I am being compensated at my usual hourly rate of $450. I am being separately reimbursed for any out-of-pocket expenses. My compensation does not depend in any way on the outcome of this case, my particular testimony, or the opinions that I express.

4. In rendering my opinions, I considered the items listed in Exhibit A, the items discussed or listed herein, as well as my own experiences in the field. I reserve the right to amend or supplement my opinions in light of further documents, depositions, or discovery disclosures.

5. I have also reviewed France Telecom's Patent L.R. Preliminary Claim Constructions and Extrinsic Evidence, dated May 3, 2013, and the evidence cited therein, as well as France Telecom's Opening Claim Construction Brief, filed June 14, 2013, and the exhibits thereto. I have also reviewed France Telecom's Opening Claim Construction Brief, dated June 14, 2013.

II. QUALIFICATIONS & EXPERIENCE

6. My qualifications can be found in my Curriculum Vitae, which includes a complete list of my publications, and is attached as Exhibit B.

7. I received a B.S. degree in Electrical Engineering in 1982, an M.S. degree in Electrical Engineering in 1984, and a Ph.D. degree in Electrical Engineering in 1987 from the University of Michigan in Ann Arbor. While I was at the University of Michigan in Ann Arbor, I received several academic honors, including my B.S. degree with honors, a best graduate

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student award and a best teaching assistant award during my M.S. study, and a best paper award from a major international conference for reporting results from my Ph.D. thesis.

8. After receiving my Ph.D., I worked at Bellcore in New Jersey from August 1987 until August 1990.

9. In September 1990, I joined the faculty at Washington University in St. Louis. I was an Assistant Professor of Electrical Engineering until June 1996. In July 1996, I was promoted to an Associate Professor of Electrical Engineering with tenure. Since July 2002, I have been an Associate Professor of Electrical and Systems Engineering at Washington University.

10. At Washington University, I have conducted research in communication, computing, and related electronic hardware and software. My research group has pioneered a new paradigm for designing electronic circuits that can alleviate the speed and performance mismatch against optical technology. I received several grants from the U.S. Federal Agencies, including the National Science Foundation and the Defense Advanced Research Project Agency, and numerous contracts from the companies and organizations around the world.

11. As a faculty member at Washington University, I have taught a number of courses in electronics, communication, and computing at both the undergraduate and graduate levels. I have supervised more than 50 students, 12 of whom received a doctoral degree under my guidance.

12. In addition to my responsibilities as a university faculty member, I have founded two companies. In May 1997, I founded MinMax Technologies, Inc., a fabless semiconductor company that developed switch fabric integrated circuit chips for the Internet. In March 1999, I founded Erlang Technology, Inc., a fabless semiconductor company that focused on the design and development of integrated circuit chips and software for the Internet. One of Erlang's products received a best product of the year award in 2004 from a major trade journal for the electronics industry.

13. Since founding MinMax Technologies, Inc. and Erlang Technology, Inc., I have served as the president for these companies for a number of years. As the president of these

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companies, I have managed the development of business plans, raised start up funding from private investors and corporations and follow-on investment from institutional investors, managed finances, recruited key technology and business employees, developed intellectual property, and handled the marketing and sales of products. I have managed MinMax and Erlang in various stages, starting from just a few employees to over 70, and raised over US $30 million in investment.

14. Outside my own start-up companies, I have also served in various technology and business advisor roles for other companies and organizations around the world. I was the main technical author for one of two winning proposals to the Korean government for CDMA wireless service licenses (1996). I have also been involved in a semiconductor company that specializes in semiconductor memories such as flash EEPROMs as a board member and as a technical advisor (2007 – 2011).

15. I am a named inventor on nine U.S. patents. I have extensively published technical papers in international conferences and journals, technical memoranda and reports, and given a number of seminars and invited talks. I have organized several international conferences and served as an international journal editor.

16. I have received several professional awards, such as the Best Paper Award at Mobility 2011 Conference in Barcelona, Spain (2011), the faculty advisor to the Most Active Student Branch in the Region 5 of the Institute of Electrical and Electronics Engineers (the "IEEE") (2009), the Wall Street Journal Businessmen of Year for Missouri (2003), the Outstanding Achievement Award by Bellcore (1990), the Best Paper Award at the 18th ISATA Conference in Florence Italy (1988), Rockwell Fellowship by Rockwell International (1985 and 1986), Outstanding Graduate Student Award by the University of Michigan (1985), and Outstanding Teaching Assistant Award by the University of Michigan (1984 and 1986).

17. I am a member of and have been actively involved in a number of professional organizations. For example, I am a Senior Member of the IEEE, the Vice Chair and Chair Elect of the Saint Louis Section of the IEEE, an Ambassador of the McDonnell International Scholars Academy, and a member of the Eta Kappa Nu Honor Society for electrical engineers.

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18. I am knowledgeable about and familiar with wireless and telecommunications systems industry standards, and as shown in Exhibit B, some of my papers describe the application of these standards in optimizing the design and testing of these systems. I am also knowledgeable and familiar with microprocessor architecture and associated software and firmware design for wireless and telecommunications terminals and base stations.

III. LEGAL STANDARDS

19. I am informed that claim construction begins with the presumption that claim terms are given their ordinary and customary meaning, and that the ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art at the time of the invention. I am informed that to determine the ordinary and customary meaning of claim terms, the Court may consult a variety of sources, including the claims themselves, the specification, the prosecution history, relevant dictionaries and treatises, and expert testimony.

20. I am informed that the claim language must be considered in the context of the entire patent, including the specification, other claims, and the prosecution history. I also understand that an inventor may clearly and explicitly define a claim term in the specification or the prosecution history to mean something other than its ordinary meaning. I understand that an inventor may also clearly and intentionally disclaim certain claim scope within the specification or prosecution history. I am informed that arguments made by the inventor during prosecution may narrow the scope of the claims or the meaning of a claim term. I am also informed that amendments by the inventor during the course of prosecution to narrow the scope of the claim should be considered as disclaiming the territory between the original claim and the amended claim. I further understand that the usage of a claim term within the specification and prosecution history may more generally provide guidance as to the intended meaning of the term. I am informed that it is not otherwise proper to read limitations from the specification into the claims or to read limitations out of the claims.

21. I am also informed that claims must be sufficiently definite so that a person of ordinary skill in the art would understand the bounds of the claims when read in light of the

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specification. I further understand that even if a claim's definition can be reduced to words, the claim is still indefinite if a person of ordinary skill in the art cannot translate the definition into a meaningfully precise claim scope.

IV. BACKGROUND OF THE TECHNOLOGY

A. Level of Ordinary Skill in the Art

22. In my opinion, for the '747 patent, a person of ordinary skill in the art at the time of the alleged invention would have at least (1) a Master's degree in electrical engineering or a related field (2) with at least three years experience in communications. I base my opinion on my review of the '747 patent, my knowledge of the prior art, and my own experience in the field.

B. Error Correction Coding

23. In the digital world, all data is represented by a series of bits -- 1s and 0s. Regardless of whether the data represents text, photos, videos, audio, etc., it is simply a sequence of 1s and 0s when in digital form.

24. Data is a "sequence" of bits in that the order matters. For example, because computers can only understand 0s and 1s, English alphabet-based characters can be numerically represented by what is known as ASCII codes. “ASCII” stands for American Standard Code for Information Interchange. For example, the letter "A" is represented by the sequence 01000001. Those same bits arranged in a different sequence represent a completely different character. Thus, the sequence 01010000, which has the same bits but in a different order, represents the letter "P." The order of the bits matters.

25. "Coding" of digital data refers to the process whereby a sequence of data bits is converted into a different sequence of data bits that represent the first sequence, often using more bits. The original data bits that are converted are referred to as the "input"; the result of the coding step is called the "output" data. For example, a very basic code could code each “0” as “00” and each “1” as “11.” Then, the sequence 01101 that is input to this coding step would output the sequence 0011110011 as the coded output.

26. The reason coding is often used to represent digital data using more bits is to

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build in redundancy when the data is transmitted. When data is sent from one place to another, there is a chance that some of the data will be lost or corrupted during transmission. By coding the data, redundancy is built in so that it is possible to reconstruct the input data on the receiving side, without having to re-transmit the data. This process is referred to as "error correction coding."

27. There are different types of coding that can be used in error correction. For example, "convolutional" coding is a specific type of error correction where the coding process is performed using at least some of the preceding input bits. Convolutional coding incorporates a concept of memory into the coding process in that the previous bits of data are also used in the coding of the current data. This can be leveraged in the decoding process to more easily identify errors and to recover the data that was lost to decode the original data properly without re-sending the data. Convolutional coding has been used for almost 60 years in several fields, including telecommunications, satellite communications, and in modem technology.

28. There is also an analogous decoding process that is used on the receiving side to reconstruct the original input data. For data that was convolutionally coded, this decoding step is usually an iterative process, where a sequence of calculations are repeated until it is confirmed that the data was correctly decoded. One of the most well-known methods of decoding convolutionally coded data is Viterbi decoding, invented by Andrew J. Viterbi in 1967.[1]

29. Coding methods can also be "systematic" where the output of the coding process ***includes*** the input data bits. Systematic coding offers the advantage that the input data is sent as part of the output. Thus, if no errors occurred during transmission, the receiver can just pull the input data as is from the received data. Systematic coding has also been used for decades. One well-known example of a systematic code is Reed-Solomon coding, developed by Irving

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[1] Andrew J. Viterbi, *Error Bounds for Convolutional Codes and an Asymptotically Optimum Decoding Algorithm*, 13 IEEE TRANSACTIONS ON INFO. THEORY 260 (1967).

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Reed and Gustave Solomon in 1960.[2] Likewise, coding methods may also be "non-systematic," where the output only includes coded data and not the original, uncoded data. Non-systematic coding was also known and used well before 1991.

30. The '747 patent claims a specific arrangement of multiple systematic convolutional coding steps that are arranged in parallel:

> 1. A method for error-correction coding of source digital data elements, comprising the steps of:
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> implementing at least two independent and parallel steps of systematic convolutional coding, each of said coding steps taking account of all of said source data elements and providing parallel outputs of distinct series of coded data elements;
>
> and temporally interleaving said source data elements to modify the order in which said source data elements are taken into account for at least one of said coding steps.

The recited individual steps -- systematic coding, convolutional coding; multiple coding arranged in parallel -- were well known in the art before the alleged invention of the '747 patent. The patent claims one particular arrangement of these well known components.

C. Reservation of Rights

31. I reserve the right to further discuss the background of the technology as necessary to support my opinions regarding the understanding of a person of ordinary skill in the art at the time of the alleged invention of the claim terms discussed below, and reserve the right to rely on my own knowledge, relevant publications, or other information disclosed by the parties. I may use graphics to explain technology and my opinions.

V. OPINIONS ON UNDERSTANDING OF ONE OF ORDINARY SKILL

32. I have reviewed Marvell's Patent L.R. 4-2 Preliminary Claim Constructions and Extrinsic Evidence, served May 3, 2013, and the Joint Claim Construction and Prehearing Statement Pursuant to Patent L.R. 4-3, filed May 17, 2013. I have reviewed the intrinsic and

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[2] Irving S. Reed and Gustave Solomon, *Polynomial Codes Over Certain Finite Fields*, 8 J. SOCIETY FOR INDUSTRIAL & APPLIED MATH. 300 (1960).

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extrinsic evidence cited therein and rely on these materials in forming my opinions.

33. I understand that France Telecom is not relying on the testimony of its own expert, Prof. Michael Mitzenmacher, but that he has provided deposition testimony on behalf of France Telecom regarding the construction of the disputed terms. I have reviewed Prof. Mitzenmacher's deposition transcript and considered it in forming my opinions.

A. "convolutional coding"

34. As I discussed above, "convolutional coding" refers to a type of coding where the calculation of the coded data is performed using at least some of the preceding input bits. For example, a bit in the input sequence may be coded using the previous *k* bits in the input sequence. Thus, the current ***and*** the prior input data are used for this calculation.

35. The '747 patent describes "convolutional codes," which are the result of a convolutional coding process:

> Convolutional codes are codes that associate at least one coded data element with each source data element, this coded data element being obtained by the summation modulo 2 of this source data element with at least one of the preceding source data elements. Thus, each coded symbol is a linear combination of the source data element to be coded and of previous data source elements taken into account.

('747 patent, col. 1:46-53.) As the patent explains, in order to create convolutional codes, the prior data bits are used by adding the current bits to the prior bits (modulo 2).

36. Patents and scholarly articles from the period of the alleged invention describe convolutional coding as it would be understood by a person of ordinary skill in the art as a process that uses the previous input bits. For example, U.S. Patent No. 5,052,000 ("Wang") notes that "the value of each bit in convolutional coding is a function of the information bits in the associated block and ***a number of priorly transmitted blocks***." (Ex. C, Wang at 1:48-54, MSIFT00039528 (emphasis added).) U.S. Patent No. 5,157,671 ("Karplus") describes convolutional coding as a set of equations where "each parity bit P(t) is computed from previous data bits v(t)." (Ex. D, Karplus at 5:8-12, FT000262.) The Berlekamp reference, Elwyn R. Berlekamp et al., *The Application of Error Controls to Communications*, 25 IEEE COMM. MAG. 44, 46 (1987), notes that for a "k=7 convolutional code," that "the value of the

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output bits depends on seven user data bits." (Ex. E, Berlekamp at MSIFT00039242.)

37. The result of a convolutional coding process depends on the sequence of input bits that are coded by the coding process. Thus, one of ordinary skill in the art would understand "convolutional coding" to mean "calculating an output data element representing current input data using current and prior input data."

38. I understand that France Telecom believes no construction is necessary, but proposed an alternate construction of "codes that associate at least one coded data element with each source data element, the coded data element being a linear combination of the source data element an some previous source data elements." In my opinion, France Telecom's alternate construction is inconsistent with the understanding of a person of ordinary skill in the art. A person of ordinary skill in the art would not understand the ***coding step*** to mean the ***codes*** that are calculated by the coding step itself.

39. As I discuss above, convolutional coding depends on the sequence of input bits that are ***coded by the coding process***. France Telecom's proposed construction does not describe a coding process that operates on the input data that is actually provided to the coding step. Instead, France Telecom's proposed construction associates a "source [data] element" with a "coded data element." These words are terms that are found in the patent claims and have special meanings in the context of the '747 patent. For example, a "source data element" refers to the data elements that are to be coded by the entire claimed coding method – not each independent coding step that is part of the claimed coding method.

40. France Telecom's proposed construction states it is a linear combination of the source data element "and some previous source data elements." However, Claim 1 requires that prior to at least one of the claimed convolutional coding steps, source data elements are temporally interleaved to "modify the order in which said source data elements are taken into account." Because the order of the source data elements is modified for this coding step, the order of the data elements from the perspective of the claimed coding method is irrelevant. Data that was previously sent to be coded by the claimed coding method may not have been input to one or more of the independent coding steps that are part of the claimed method

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because of the interleaving step. This shows the importance of defining the coding step in relation to each constituent coding step, rather than the claimed coding method as a whole.

41. Because France Telecom's proposed construction does not define "convolutional coding" in terms of the sequence of data that is actually input to the coding step, it is inconsistent with the understanding of a person of ordinary skill in the art at the time of the invention.

B. "systematic convolutional coding"

42. "Systematic convolutional coding" simply refers to a step of convolutional coding that is systematic. As I discussed above, a person of ordinary skill in the art would understand that "systematic" coding is a process where the input data bits are part of the output of the coding step. The output also includes coded data. A person of ordinary skill in the art reading the ‘747 patent would not understand that the term is being given a special meaning. The patent merely discusses that the disclosed coding modules as "of any known systematic type." ('747 patent, col. 7:60-61.)

43. There are numerous scholarly articles that reflect the understanding of a person of ordinary skill in the art at the time of the alleged invention of what it means for a coding to be "systematic." The Ungerboeck article, Gottfried Ungerboeck, *Trellis-Coded Modulation with Redundant Signal Sets*, 25 IEEE COMM. MAG. 5 (1987), notes that "[w]ith a systematic encoder, ***the input bits appear unchanged at the output***." (Ex. F, Ungerboeck at MSIFT00039463 (emphasis added).) Tom Fuja *et al.*, *Cross Parity Check Convolutional Codes*, 35 IEEE TRANSACTIONS ON INFO. THEORY 1264, 1268 (1989) notes that a systematic generator (i.e., coder) causes the input message sequences "to be reproduced exactly in the code sequences." (Ex. G, Fuja at MSIFT00040383.)

44. A person of ordinary skill in the art would understand that systematic convolutional coding simply refers to a convolutional coding where the bits input to the coding step are included in the output of the coding step along with the coded data. As G. David Forney, *Convolutional Codes I: Algebraic Structure*, 16 IEEE TRANSACTIONS ON INFO. THEORY 720, 720-21 (1970), explains:

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> Fig. 1(a) shows a simple binary systematic rate-1/2 convolutional encoder of constraint length 2. . . . The outputs are two binary sequences y_1 and y_2 (hence the rate is 1/2). The first output sequence y_1 is simply equal to the input x (hence the code is systematic).

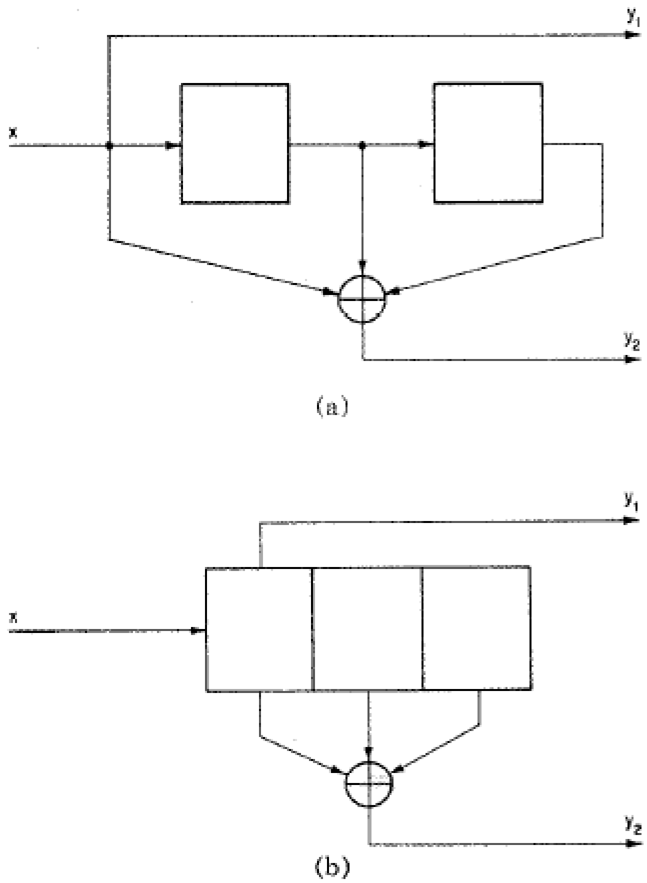

Fig. 1. (a) A rate-1/2 systematic convolutional encoder. (b) Alternate representation.

(Ex. H, Forney at MSIFT00040392-93.)

45. The common theme in all of these references is that the coding step includes the input data as part of the coded output. (Ex. F, Ungerboeck at MSIFT00039463; Ex. G, Fuja at MSIFT00040383; Ex. I, Massey at MSIFT00040411-12; Ex. J, Yuen at MSIFT00040238; Ex. H, Forney at MSIFT00040392-93; Ex. K, Lin at MSIFT00040319-20; Ex. L, Sweeney at MSIFT00040356; Ex. M, Viterbi at MSIFT00040436; Ex. N, Sklar at MSIFT00040421-22; Ex. O, Sklar 2000 at MSIFT00040375; Ex, P, Poli at MSIFT00040347.) Thus, a person of ordinary skill in the art would understand "systematic convolutional coding" to mean "convolutional coding where the output includes both the coded data and the current input data."

46. I understand that France Telecom believes no construction is necessary, but

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proposed an alternate construction of "convolutional coding where the source data is transmitted jointly with coded data elements." In my opinion, France Telecom's alternate construction is inconsistent with the understanding of a person of ordinary skill in the art.

47. France Telecom’s contention that a coding step is “systematic” as long as the source data is merely “transmitted jointly” with the coded data elements is inconsistent with the understanding of a person of ordinary skill in the art. As I discuss above, systematic coding is a particular kind of coding where the input data is provided as part of the output. Under France Telecom’s definition, a non-systematic coding step would become systematic if some external source wholly unrelated to the coding step provides the input data to be transmitted with the coded output of the non-systematic coding step. In essence, the same coding step could be systematic or non-systematic, depending on the context in which the coding step is used. That is inconsistent with the understanding of a person of ordinary skill in the art, who would understand that the coding step itself includes the input data as part of the output.

48. France Telecom's proposed construction also suffers the same flaw because it would consider a coding step to be “systematic” even though the data input to that coding step is not included in the output of that coding step. France Telecom’s construction simply requires the source data elements – the sequence of bits to be coded by the claimed coding method – to be transmitted with the output. It does not require that the sequence of bits that are actually input to be coded by each independent coding step be included in the output of each coding step.

C. "at least two independent and parallel steps of systematic convolutional coding"

49. A person of ordinary skill in the art would understand that multiple coding steps may be used in order to improve the performance and/or effectiveness of the coding process. When multiple coding steps are used, they can be variously arranged, but the following two ways are very common: in series or in parallel. The concept of series and parallel coding were both known to persons of ordinary skill in the art.

50. When coding steps are conducted in series, they are performed one after another.

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In other words, the output from a first coding step is used as the input to the second coding step. The input data undergoes two coding steps when coding is done in series. A person of ordinary skill in the art would understand that such an arrangement can increase the effectiveness of error correction, but at the cost of latency. Latency is increased because it takes longer to sequentially code the data using two coding steps instead of using a single coding step.

51. On the other hand, coding steps can be performed in parallel, where they are performed concurrently or simultaneously. In a parallel arrangement, the output of one coding step is not used as the input to another coding step. A person of ordinary skill in the art would understand that, because the coding steps do not depend on one another, they can be performed simultaneously.

52. The '747 patent discloses a method using multiple systematic convolutional coding steps arranged in parallel. The patent alleges that "[t]he present invention relies on two novel concepts, namely ***a coding method simultaneously carrying out several coding operations***, in parallel, and a method of iterative coding." ('747 patent, col. 7:31-34 (emphasis added).) This parallel arrangement allows the multiple coding steps to be carried out simultaneously or concurrently, which improves performance. Because the parallel coding steps are independent, one coding step does not have to wait for another coding step to finish before performing its calculation. This is unlike coding steps arranged in series where the second coding step has to wait until the first coding step is complete. In other words, they are separate and distinct. This approach reduces the latency.

53. The ‘747 patent file history confirms that the multiple coding steps are carried out simultaneously. In an amendment, the patentee distinguished the claimed invention from the Betts prior art reference, which disclosed multiple decoders that “are used only one at a time.” (Ex. Q, ‘747 patent file history at FT000244 (Jul. 22, 1994 Amendment).)

54. Furthermore, a person of ordinary skill in the art would understand that the context of the claim language describes the independent and parallel steps as referring to "systematic convolutional coding." In other words each of the coding steps must be systematic and convolutional.

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55. Thus, it is my opinion that a person of ordinary skill in the art would understand "at least two independent and parallel steps of systematic convolutional coding" to mean "at least two separate and distinct steps of systematic convolutional coding, not in series, simultaneously carried out."

56. I understand that France Telecom believes no construction is necessary, but proposed an alternate construction of "at least two steps of systematic convolutional coding that are not serially concatenated, including without limitation as shown in Figures 1 and 2." In my opinion, not only is France Telecom's alternate construction inconsistent with the understanding of a person of ordinary skill in the art, adopting this construction would render Claim 1 insolvably ambiguous and would not provide a meaningfully precise claim scope.

57. A person of ordinary skill would understand that ***each*** of the at least two independent steps must be systematic convolutional coding steps. Under France Telecom's construction, however, it is impossible to have a situation where only one coding step is systematic and the other coding step is non-systematic. Because the "source data" is "transmitted jointly" for one of the coding step, under France Telecom's construction both coding steps would be considered "systematic." In other words, the systematic nature of the recited coding steps are dependent on one another.

58. France Telecom's attempt to define the term in context of figures that contradict the term that they seek to define would provide no guidance to a person of ordinary skill in the art as to the scope of the alleged invention. In my opinion, a person of ordinary skill in the art would not be able to determine a meaningful claim scope under France Telecom's construction. As depicted, Figures 1 and 2 show two coding steps arranged in parallel where only one of the two coding steps is systematic. It is possible that there are additional inputs and outputs that are not shown in these figures, but if the figures are intended to be complete, they simply do not illustrate two steps of systematic convolutional coding, as understood by a person of ordinary skill in the art. As I discussed above, a systematic convolutional coding step ***must*** output both the coded data ***and*** the input data. Thus, when two independent and parallel systematic convolutional coding steps are performed, ***each*** independent coding step must output its

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respective coded data and input data. This is apparent from the plain and ordinary meaning of the claim term itself.

59. In addition, I understand that France Telecom argues that because the patent notes a delay step may be performed after the interleaving step, this means the coding steps do not need to be simultaneously carried out. In its brief, France Telecom cites the limitation of dependent Claim 4, which recites “A method according to claim 1, wherein each of said temporal interleaving steps is followed by a delay step . . . .” (FT’s Br. at 16 (quoting ‘747 patent, col. 14:66-68).) But one of ordinary skill in the art would understand that introducing a delay step would not change the requirement that parallel operations must be carried out simultaneously. A delay step would simply make the operation of the two steps asynchronous. In other words, if a delay step is implemented, the first coding step may start coding its input data, and then some clock cycles later, the second coding step may start coding its input data. In that scenario, a person of ordinary skill in the art would understand that both coding steps are still carried out simultaneously.

60. For these reasons, it is my opinion that France Telecom's alternate construction is inconsistent with the understanding of a person of ordinary skill in the art at the time of the invention and would not provide a meaningfully precise claim scope.

D. "data element"

61. The ‘747 patent makes clear that the field of the invention is “the coding of digital data.” (‘747 patent, col. 1:10-11.) As discussed above, all digital data consists of sequences of bits -- 1s and 0s. Regardless of what the bits represent (e.g., text, photos, video, audio, etc.), they are represented by a sequence of bits. Thus, one of ordinary skill in the art would understand that the data elements discussed and covered by the patent refer to bits of data.

62. These bits of data are not necessarily processed one bit at a time (although they may be processed bit-by-bit). Instead, they can be operated on in groups, often referred to as "blocks."

63. In the '747 patent, the disclosed coding and decoding methods operate on "data

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elements" that are treated as a single block of data. The patent describes the coding steps operating on data elements: "Each source data element d to be coded is directed, firstly, towards a first coding module 11 and, secondly, towards an [*sic*] temporal interleaving module 12 which itself feed [*sic*] a second coding module 13." ('747 patent, col. 7:50-59.) Claim 1 describes a process of temporal interleaving to "modify the order in which said source data elements are taken into account." ('747 patent, col. 14:53-56.) Each claimed step operates on "data elements" that are bits that are considered as a block.

64. The patent further makes clear that these data elements are made up of bits or sequences of bits.

> Convolutional codes are codes that associate at least one coded data element with each source data element, this coded data element being obtained by ***the summation modulo 2 of this source data element*** with at least one of the preceding source data elements. Thus, each coded symbol is a linear combination of the source data element to be coded and of previous data source elements taken into account. The Viterbi algorithm, taking account of a sequence of received coded symbols, gives an estimation of each data element coded at transmission, in determining the source sequence that most probably corresponds to the received sequence.

('747 patent, col. 1:46-57.) "Summation modulo 2" is a mathematical calculation that is a simple variation of ordinary addition where the result is either 0 or 1. In modulo 2 addition, the values are added together and then divided by 2, with the remainder being the result of the addition. For example, summation modulo 2 of 1 plus 1 results in 0 (1 + 1 = 2; remainder of 2 divided by 2 being 0). In other words, 1 is the maximum value in this system (as in a counter where once the number reaches 2, it immediately resets to 0). Modulo 2 is a mathematic operation that is used for bits, where the only possible values are 0 and 1.

65. A person of ordinary skill in the art reading the disclosure of the patent would understand that the only data elements disclosed are digital data expressed as bits or series of bits of data capable of being coded; no other type of data is disclosed in the patent. Thus, the patent itself make clear that a data element is (1) made up of 0s and 1s and (2) can be treated as a block. Therefore one of ordinary skill in the art would understand "data element" to mean "bits (1 or 0) or series of bits (i.e., a sequence of 1s and 0s) to be considered as a block."

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66. I understand that France Telecom believes no construction is necessary, but proposed an alternate construction of "a single unit of data." While a person of ordinary skill in the art may not view France Telecom's alternate construction as incorrect, it is vague and imprecise.

67. First, in the context of digital data, all data is represented by bits. I understand that France Telecom objects to Marvell’s proposed construction because it alleges that data coded by the ‘747 patent method can be symbols or real values. However, the ‘747 patent is directed to “the coding of digital data” (‘747 patent, col. 1:10-12), which a person of ordinary skill in the art would understand refers to bits of data. While the bits of bits that are coded by the claimed method may represent symbols or real values, they are expressed as bits of data in order to be coded. For example, the ‘747 patent notes that real variables are “samples coded on n bits (typically n=4).” (‘747 patent, col. 11:30-32.) That is, real variables are represented by a series of bits. This is consistent with the understanding of a person of ordinary skill in the art.

68. I understand that France Telecom may contend that a circuit may transmit a real number as a voltage value rather than converting the number into bits, for example by sending a voltage value between 0 and 10 to represent those values. I disagree. The ‘747 patent is directed to error correction coding used in data transmission. An arrangement where voltage values are transmitted to represent real values cannot be corrected by the receiver and thus would not be understood by one of ordinary skill in the art to be the subject of the ‘747 patent.

69. Error correction coding is a mathematical operation. As I testified during my deposition, in order to implement error correction coding, one should be aware of how chips or circuits are built. A person of ordinary skill in the art, having experience designing and building chips and circuitry used for error correction, would understand that real values or symbols will have to be converted to bits in order to be error-correction coded.

70. Second, in digital data, a "block" is a well-understood concept to a person of ordinary skill in the art that refers to a collection of bits of data that are transmitted or otherwise processed together. In contrast, the word "unit" is vague and can refer to a single bit, a single symbol (as represented by a series of bits), or a collection of symbols. In my opinion, the word

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"unit" does not provide any guidance to a person of ordinary skill in the art.

E. Reservation of Rights

71. The opinions provided in this declaration are offered only to explain how a person of ordinary skill in the art at the time of the alleged invention would understand the meanings of the claim terms discussed above. I reserve the right to discuss any claim limitations at issue or that become at issue as the case develops, as well as the plain and ordinary meaning of any claim term, based on the intrinsic evidence, extrinsic evidence, and on my experience and knowledge in the subject matter of the claimed invention.

I declare under penalty of perjury of the laws of the United States that the foregoing is true and correct.

DATED: June 28, 2013

Executed in St. Louis, MO

Paul S. Min, Ph.D.